

LARVAL CHARACTERISTICS OF SOME NORTH DAKOTA CARABIDS (COLEOPTERA: CARABIDAE)

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Records of adult Carabid beetles collected in North Dakota indicate that at least 164 species occur within the boundaries of the state. Adult specimens in the collection of the Department of Entomology, North Dakota State University at Fargo, were examined and identified by Dr. W. C. Stehr of Ohio University at Athens, Ohio, in 1959.

The larvae of only a few of these ground beetles have been described. These include *Calosoma obsoletum* Say and *C. calidum* (Fab.) by Burgess and Collins (1917); *Poecilus lucublandus* Say, *Chlaenius sericeus* (Forst.), and *Galerita janus* Fab. by Dimmock and Knab (1904); *Harpalus pennsylvanicus* (DeG.) figured by Quaintance and Jenne (1912); *H. herbivagus* Say figured by Lugger (1899); and *H. compar* Lec., *Chlaenius pennsylvanicus* Say, and *Stenelophus conjunctus* Say by Chu (1945).

Van Emden (1942) in England made a comprehensive study of the Carabid larvae and prepared a descriptive key to the tribes and genera. This work serves as the chief source of background material for the present study, aiding in the recognition of larvae and providing descriptive terms for significant structures.

Because the larvae of the majority of the Carabid species are undescribed, the objective of this study was to contribute to the knowledge of this group.

METHODS AND PROCEDURE

COLLECTING

A portion of the material used in the study was obtained by field collecting. This was confined mainly to Cass County. Attempts at collecting early in the season (June 8-22) met with little success. During the period, July 1 to July 20, larvae were more abundant. Best results were obtained in wooded areas near water. Larvae, pupae, and adults were found in such situations under fallen logs and other debris. One of the most productive areas was near a bridge construction site where the ground was littered with debris. Larvae were difficult to find in cultivated fields early in the season.

Use of a posthole digger for sampling, particularly in cultivated fields, did not prove successful. The most satisfactory collecting equipment proved to be a hand trowel and a glass jar. Under logs and debris larvae were fairly close to the soil's surface, but some were found at a depth of four to six inches in damp soil with an abundance of humus. A light

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² Published with the approval of the Director, N. D. Agr. Expt. Sta. as Paper No. 76 of the Journal Series.

forceps was first used to pick up the insects, but injury may have been sustained by some that did not survive. Picking them up with the point of a trowel along with some soil was a better method. Considering the active nature of the carabid larvae, an advantage of this method was that one hand could be used for both digging and collecting. Care was taken to separate larvae into individual containers as soon as possible. Cannibalism frequently occurred within an hour after collecting.

An attempt was made to collect two or more larvae of each apparent species so that some could be reared and some preserved as life-like as possible for study. Larval exuviae were retrieved and preserved as an additional check on the identity of preserved larvae, once the identity of a reared adult had been established.

In order to study specimens they were first placed under refrigeration at 45 degrees F. for two hours in individual salve boxes. After this period their activity was sufficiently reduced to make microscopic examination possible. When two larvae were determined to be identical, one was boiled in water and preserved in 80 per cent ethyl alcohol and the other one was returned to the culture box for rearing.

REARING

Each larva was placed in a two-ounce tin salve box containing damp soil. Though moisture was essential, if the soil became too wet, the insects did not survive. A few drops of water added about every three days provided sufficient moisture if the culture was initially damp.

Soil from the natural habitat of the larva was used in most cases and proved satisfactory. However, in several boxes, larvae were placed in soil mixed for greenhouse use. The mixture was not sterilized and in nearly every culture the pupa was destroyed by mites.

Food for the larvae was gathered by sweeping alfalfa and grasses for lepidopterous larvae. Several species, mostly noctuids, were consumed as well as very small earthworms which existed in the natural environment of the Carabidae. One lepidopterous larva every two or three days provided sufficient food to maintain the carabid larva to pupation period. In many cases mature larvae pupated within a few days after collection.

For recording purposes, the living larvae, identical preserved specimens, cast skins and reared adults were all assigned the same number.

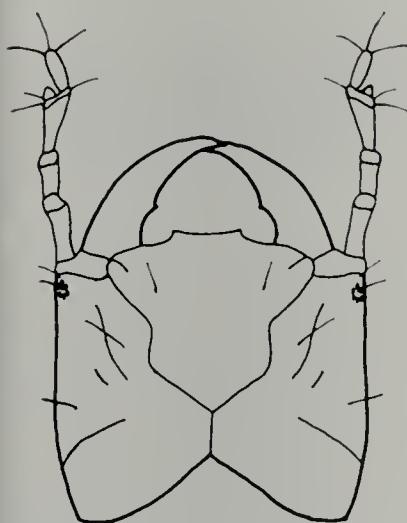
MATERIAL AND DESCRIPTIONS

Descriptions of identified larvae were based on insects taken as larvae and reared to the adult stage. The species reared and the numbers involved are reported with their descriptions.

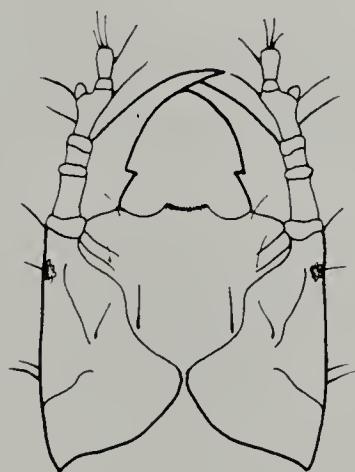
Micromaseus femoralis (Kirby)

The description is based on one reared specimen and one preserved specimen, both taken in Cass County in July. The reared insect remained in the pupal stage only 4 days.

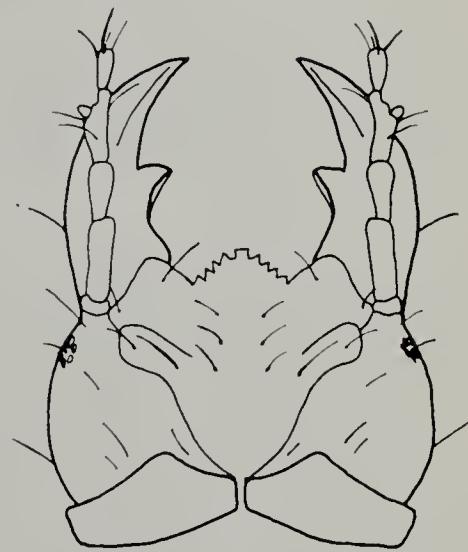
Head. Slightly broader than long and slightly narrower than prothorax and not strongly constricted posteriorly. Antennae extending forward beyond mandibles, first 2 segments cylindrical, second about three-fourths length of first, third with exterior margin angular and subequal in length to first, fourth about one-half the length of third. Sensorial appendage of third antennal segment conical with diameter of base subequal to height. Mandible with small triangular retinaculum located about two-fifths distance from base to apex. First segment of labial palps with single seta on inner margin. Maxillary palps with each segment smaller in diameter than the preceding from base to apex, first and fourth subequal in length, second and third subequal in length, first about as broad as long, fourth much longer than broad. Outer lobe of maxilla with first segment about one and one-fourth times as long as second. Inner lobe an apparently unsegmented projection with strong terminal seta. Nasale concave, without regular denticulation and with projecting outer limits. Fronto-clypeal area with single pair of prominent setae. Six ocelli on each side arranged in transverse arcs with a pigmented area just caudad of anterior 3, prominent seta just anterior to uppermost of posterior 3 and another anterior to second of this group. Ocellar grooves and cervical grooves prominent, former curving parallel with frontal sutures, latter paralleling cervical margin of head. Stem of epicranial suture short, about one-seventh as long as fronto-clypeal area. Cervical triangle large and lightly sclerotized.



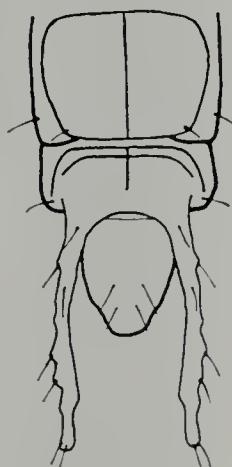
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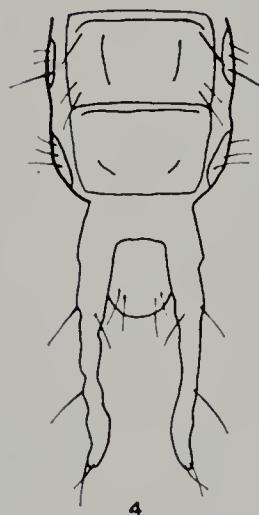
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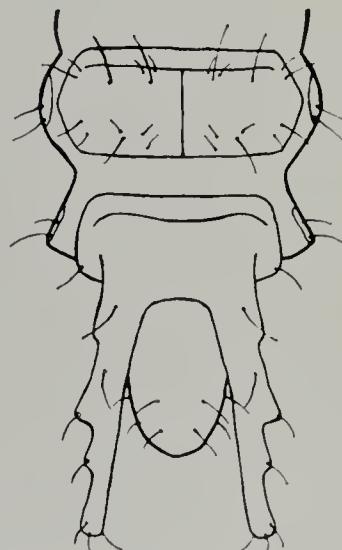
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FIGURES 1-6, Dorsal aspects of head (upper row) and abdominal segments 8 through 10 (lower row) of some carabid larvae. 1-2, *Micromaseus femoralis* (Kby.). 3-4, *Amara cupreolata* (Ptzys.). 5-6, *Anadaptus discoideus* (Dej.).

Thorax. Tergites margined anteriorly, pronotum completely margined. Prothorax approximately one and one-half times as long as mesothorax which is subequal to metathorax; tergum with 4 prominent setae along each lateral margin and an additional seta dorsad of the most anterior on each side; mesal longitudinal groove prominent, lateral furrows straight, running perpendicularly to meson one-third of distance from anterior margin of tergum to posterior. Pleural sclerites long and contiguous with pronotum, divided into 2 triangular plates on meso- and metathorax. Prosternum forming a subtriangular plate. Legs of medium length with two equal claws. Femora with double row of 5 to 7 irregular spines on ventral surface.

Abdomen. Segments gradually tapering caudally. Tergites covering most or all of dorsal surface, margined anteriorly and laterally for anterior half. Tergites with single prominent seta at each posterolateral corner. Epipleurites 1, 2, 3, and 8 each with 1 large and 2 small setae, fourth through seventh with 1 large and 1 small. First and second hypopleurites with 2 large and 1 small setae, third through eighth with a single large seta. Ninth segment two-thirds as long as eighth. Cerci twice as long as ninth segment, non-articulating, at first diverging then converging with tips almost parallel. Nine setae present on each cercus with all but first and last two on a distinct nodule. Tenth segment approximately as long as ninth and visible dorsally, extending caudally for about half length of cerci. Length of extended full grown larvae, 12 mm.

Amara cupreolata (Putzeys)

Two specimens collected in July, pupated ten days later and emerged as adults six days after pupation. The following description is based on these specimens and a preserved complete larva. All were taken in Cass County.

Head. Slightly longer than broad, of approximately same width as prothorax, not constricted posteriorly. Antennae extending forward slightly beyond mandibles, first 2 segments subcylindrical, second about one-half times length of first, their apical diameters subequal. Third antennal segment has exterior margin angular and is subequal in length to first. Sensorial appendage of third segment is conical with height one-half times diameter of base. Fourth segment is cylindrical and subequal in length to second. Third segment bears 3 setae, 2 on outer margin caudad to sensorial appendage, third on inner margin near the apical end of segment. Fourth bears 3 setae apically and another at about middle of inner side. Mandible without teeth but with small triangular retinaculum located on basal third. Labial palps with first segment longer than second, first subcylindrical, second cylindrical tapering to a rounded apex, basal diameter of second about one-half that of first. Ligula absent or reduced with 2 strong setae. Stipes of maxillae with 2 prominent setae, 1 on outer margin slightly below middle, second located dorsally on apical fourth. Inner lobe of maxilla reduced to an apparently unsegmented projection bearing strong terminal seta. Outer lobe with first segment cylindrical, second subconical with a rounded apex, about three-fourths length of first and with basal diameter one-half that of first. Maxillary palps with second segment two and one-half times length of first and subequal to combined lengths of third and fourth. Basal diameter of third segment is one-half that of second and twice that of fourth. Nasale slightly concave and with dense row of setae along concave margin. Adnasales not prominent but each bearing strong seta. Frontal clypeal area with 3 pairs of darkened ridges, 2 curving obliquely backward from antero-lateral margins, third parallel with mesal line and adjacent to sutures of posterior portion of fronto-clypeal area. With single pair of setae near inner end of median ridge on either side. Frontal piece not touching hind margin of head, epicranial suture short. Six ocelli on each side arranged in 2 transverse arcs just posterior to base of antenna with a darker pigmented area between ocelli. One strong seta located within ocellar area on either side. Ocellar and cervical groove present, former parallel to frontal sutures, latter running parallel to hind margin of head. Two strong setae located one on either side of frontoclypeal area mesad to caudal end of ocellar groove. Another seta located on either side of outer margin of head just anterior to seta just described.

Thorax. Meso- and metatergites margined anteriorly, mesal longitudinal line prominent. Prothorax only slightly longer than other segments. Pronotum with 3 setae on each side, 1 in antero-lateral corner, a second midway along lateral margin, and third located obliquely dorsad; others near posterior margin. Two additional small setae located in a line dorsad of anterior seta and 1 small seta located ventrad of posterior seta. Meso- and metanota differ in that so-called posterior seta is located almost directly dorsad of median seta and additional small posterior seta is lacking. Pleural sclerites are contiguous with pronotum faintly sclerotized but separate from meso- and metanota, bearing 1 seta each. Legs of medium length with 2 equal claws. Femur and tibia each with a transverse row of 3 or 4 spines on ventral side.

Abdomen. Segments gradually tapering caudally. Tergites covering most of the dorsal surface, margined anteriorly; mesal longitudinal groove prominent, with single prominent seta on each postero-lateral corner of each segment, another smaller seta at posterior ends of marginal groove and another small seta near large posterior seta. Epipleurites with 1 large and 2 small setae. Hypopleurites with 1 prominent seta and an additional small seta on some. Ninth and tenth segments subequal in length. Cerci approximately two and one-half times length of ninth segment, non-articulating, diverging for basal third, then almost parallel to tips. Five setae present on each cercus.

Anadaptus discoideus (Dejean)

Six larvae, collected in Cass County, were reared to maturity on July 18-20. These remained in the pupal stage for six days. In addition to the six exuviae, sixteen other larvae were examined and considered identical. All were from Cass County and were taken during the period June 20 to August 5.

Overall appearance. Larva appearing brown, head, meso- and metanota and abdominal tergites testaceous, pronotum deep brown, almost black. Remaining sclerites and legs are paler, the non-sclerotized area near white. Extended length of the full grown larva is 18.6 mm.

Head. Slightly broader than long, slightly narrower than prothorax and distinctly constricted posteriorly. Width 2.2 mm. Antennae extending forward as far as mandibles, first segment cylindrical, second subcylindrical, and three-fourths as long as first, third as long as second with outer margin excavated for apical third, fourth about one-half length of third and more slender. Sensorial appendage on third segment is conical with diameter of base subequal to height. Three setae arise from third and 4 from fourth segment, 3 of them prominent, fourth less evident. Mandible strong and somewhat flattened with prominent pointed retinaculum located nearly midway between base and apex and 1 seta extending from midpoint of lateral margin. First segment of labial palps cylindrical, second less than one-half length of first and very slender, tapering toward apex, mentum with several scattered setae, 2 prominent setae extending ventrally, ligula broadly triangular with 2 closely parallel setae. Stipes of maxillae rather slender with a fringe of long hair along median margin and 3 or 4 setae on lateral margin. Maxillary palps with each segment smaller in diameter than preceding from base to apex. First segment of palps short, nearly as broad as long. Second segment one and one-half times as long as third and tapering toward apex. Outer lobe of maxilla with first segment about one and one-fourth times length of second and with a prominent seta on apical third; second slender and tapering toward apex. Inner lobe an apparently unsegmented projection with strong terminal seta. Nasale projecting forward with blunt central tooth and 4 prominent, pointed teeth on either side. Adnasales prominent, projecting nearly as far anteriorly as central tooth of nasale. Frontoclypeal area with prominent seta on either side posterior to inner end of clypeal groove, a somewhat less prominent seta behind junction of frontal and clypeal grooves on each side and a similar pair along each margin caudo-laterally from adnasale, and 3 pairs of shorter setae extending backwards from nasale in two diverging arcs. Additional finer setae also present. Six ocelli arranged in 2 transverse areas on each side with a pigmented area and a prominent seta between them.

Ocellar furrow lacking, cervical groove prominent, extending obliquely forward for about two-fifths of the distance between epicranial suture and ocelli, then bending backward in a straight line perpendicular to longitudinal axis of head, though not parallel with sinuate hind margin of head. Epicranial suture short, about one-sixth as long as fronto-clypeal area. Cervical triangle large, lightly sclerotized and with broadly rounded apex. Strong seta located on either side of head just antero-laterad of bend in cervical groove; 2 short setae present on either side, 1 just behind antenna, a second in line with this and midway between it and strong seta. A second prominent seta found on side of head laterad of strong seta and 2 small setae found on either side just anterior to cervical groove, one near frontal suture, other midway between bend and side of head.

Thorax. Pronotum margined on all sides; meso- and metanota margined anteriorly. Prothorax almost twice as long as either of other segments. Pronotum with 2 rows of 3 setae on each side, one row posterior to anterior margin, other anterior to posterior marginal line. Meso- and metatergites with large seta midway along lateral margin and 2 unequal lesser setae at antero-lateral corner on each side, 4 regularly spaced setae varying in size in a transverse line plus an occasional additional anterior seta on each side and three setae in a transverse line posteriorly on each side, 2 outer setae large, mesal small. Sternites lightly sclerotized with 2 rows of short setae converging posteriorly. Mesothoracic spiracle elliptical and prominent. Legs of a uniform light color. Coxae with double row of setae on outer surface plus 2 additional setae forming a ring of 4 at distal end. Tarsus with 2 unequal claws subtended by 2 short, stout setae.

Abdomen. First 5 segments rather broad; segments 6 through 9 tapering caudally. Tergites covering one-half to two-thirds of dorsal surface, margined anteriorly, with 2 transverse rows of setae. These consist of 3 well-spaced prominent setae on either side of mesal line anteriorly and 2 well-spaced prominent setae posteriorly plus a small seta in line on either side of upper seta posteriorly, a small seta between 2 rows on lateral margin on first 5 tergites and several small setae appearing irregularly in association with large anterior setae. First epipleurite with 3 or 4 setae, second through eighth with 4 or 5 setae, ninth pleurite with 3 setae. First hypopleurite apparently subdivided with seta on each part; remaining hypopleurites with 3 or 4 setae. Ninth segment two-thirds as long as eighth. Cerci more than twice as long as ninth segment, at first diverging and then continuing almost parallel to apex, non-anticulating at base with 8 setae on each cercus and all but first and last 2 on a distinct nodule. Tenth segment slightly longer than ninth, cylindrical and directed ventrally at about a 30 degree angle.

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